Remarks/Arguments

Claims 1-16 remain in the application. Claims 1-8, 10, and 14 have been amended.

Claims 1-7 and 10 have been amended in order to avoid invoking 35 U.S.C. 112, sixth paragraph. In particular, all instances of phrases such as --the steps of--, and -- the step of-- have been deleted. Applicant wishes to note for the record that the amendments are not intended to be narrowing, nor are the amendments being made for a reason related substantially to patentability. Applicant respectfully submits that no new matter has been added in the amendments.

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Applicant is submitting under separate cover an Information Disclosure Statement including United States Patent No. 6,571,615 and an English language abstract of JP 59-226197. US 6,571,615 is a national phase application of PCT FR99/01541 (WO 00/00807), which was originally submitted with the Information Disclosure Statement dated Feb. 01 2002.

Claim Rejections – 35 USC 112

Claim 8 recites the limitation "the sensor" in line 2. There is insufficient antecedent basis for this limitation in the claim.

Applicant has amended claim 8. Applicant respectfully submits that amended claim 8 is in compliance with 35 U.S.C. 112. The amendment does not add new subject matter.

Claim Rejections – 35 USC § 102

Claims 10-11 and 13 are rejected under 35 U.S.C. 102(b) as being unpatentable by Cantrell et al. (U.S. Pat 6,197,130).

Applicant respectfully submits that the 102(b) rejection is improper in view of the effective date of the reference not being more than one year before the filing date of the present application. Applicant has assumed that the Examiner intended to make the rejection under 35 USC 102(a). If this is the case, then Applicant wishes to present the following arguments in favor of the patentability of claims 10-11 and 13. In the event that Applicant's assumption is not valid, then Applicant requests of the Examiner further clarification in this regard.

Applicant has amended claim 10. In particular "the step of comparing" lacks proper antecedent basis and has been amended to read --the step of determining--. No new matter has been added.

Referring still to amended claim 10, Applicant discloses and claims a method for predicting precipitation kinetics in precipitation-hardenable alloys defined by the following features (emphasis added):

a) providing an initial value in dependence upon first and second inter-convertible precipitate phases of the alloy;
b) providing data indicative of thermal exposure of the alloy;
c) **calculating a value according to predetermined rate equations** in dependence upon the provided initial value and the provided data;
d) **determining a value indicative of a current precipitate-phase composition** of the alloy **in dependence upon the calculated value**; and,
e) affecting the alloy in dependence upon a result of the step of determining.

The above features define a highly advantageous process for predicting strength and corrosion resistance of precipitation-hardenable alloys by predicting precipitation kinetics. First, a set of initial values is provided in dependence upon the identity of the precipitation-hardenable alloy – a). Second, data indicative of thermal exposure of the alloy, for example, the absolute temperature of the alloy at a time instance during heat treating is provided - b). Based on the data provided, a value is calculated according to predetermined **rate equations** – c). From the value determined in c) a value indicative of a current precipitate-phase composition of the alloy is determined – d). Knowing the current

precipitate-phase composition allows, for example, determining further heat treating steps in order to achieve predetermined properties such as strength and corrosion resistance of the alloy.

Cantrell et al. teach a method and apparatus for non-destructive testing during heat treating of an alloy. During heat treating a workpiece is insonified with an ultrasonic signal. A second harmonic of an acoustic response signal is monitored and used to indicate changes in material strength of the workpiece. In order to relate changes of the second harmonic – or a non-linearity parameter – to the hardness of the workpiece, a calibration process is performed. In the calibration process, samples are taken in predetermined time intervals during a heat treating process, cooled to room temperature, and a Vickers hardness test is performed. Accordingly, Cantrell et al. merely teach a method based upon measuring a physical property of a workpiece during heat treatment and stopping the heat treatment when the measured physical property is a desired value.

Applicant respectfully submits, that Cantrell et al. do not teach each and every feature of the instant invention in as complete detail as is recited at amended claim 10. In particular, at col. 4 lines 23-28, Cantrell et al. teach utilizing the signal measurements to calculate the acoustic non-linearity parameter, which can be used to indicate changes in material strength or hardness, **not** "***calculating a value according to predetermined rate equations*** *in dependence upon the provided initial value and the provided data*". In other words, Cantrell et al. teach calculating a parameter relating the acoustic response signal to material strength or hardness, while claim feature c) defines calculation of a value according to predetermined rate equations. Significantly, Cantrell et al. define the calculation of the acoustic non-linearity parameter at col. 3, lines 31-37. Applicant respectfully submits that the calculation disclosed by Cantrell et al. is based entirely upon parameters associated with the acoustic signal (e.g. amplitude of the fundamental and second harmonic signal, wave propagation distance and wave number). Cantrell et al. does not teach calculating a value according to predetermined rate equations. In addition, at col. 2 line 62 through col.3 line 8, Cantrell et al. teach determining a peak in the acoustic non-linearity parameter corresponding to maximum material strength, **not** "***determining a***

value indicative of a current precipitate-phase composition** of the alloy **in dependence upon the calculated value". Determining a point in the heat treatment process at which maximum material strength is achieved based upon a peak in the acoustic non-linearity parameter is not equivalent to determining a **value** that is indicative of a current precipitate-phase composition of the alloy, as is claimed at amended claim 10.

Applicant respectfully submits that amended claim 10 is not anticipated by Cantrell et al. and, therefore, is allowable.

Referring to dependent claim 11, Applicant discloses and claims the method defined by the features of amended claim 10, further comprising the features of: "*the provided initial value comprises a value indicative of an initial precipitate-phase composition of the alloy*". In col. 3 lines 43-58, Cantrell et al. explain a diagram shown in Fig. 1 illustrating the non-linearity parameter as function of time for heat treatment at 190 °C. However, Cantrell et al. do not teach a value indicative of an initial precipitate-phase composition, but merely state that beginning heat treatment results in increased material strength and increased value of the non-linearity parameter.

Referring to dependent claim 13, Applicant discloses and claims the method defined by the features of claim 10, further comprising the features of: "*the provided data is a simulated thermal exposure history of the alloy*". In col. 3 lines 1-8, Cantrell et al. teach that there are a known number of precipitates which contribute to the materials heat treated strength. Thus, for a given alloy there is a given number of peaks in the non-linearity parameter expected. Once the peak corresponding to maximum material strength is determined the heat treatment process can be controlled through a feedback system, the heat treatment ending when the appropriate peak in the acoustic non-linearity parameter is detected. As is evident, Cantrell et al. do not teach anything similar to a simulated thermal exposure history of the alloy.

Applicant respectfully submits that each of claims 11 and 13 depend on a claim that is believed to be allowable and as such are also allowable.

Claim Rejections – 35 USC § 103

Claims 1-8, 12 and 14-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cantrell et al (U.S. Pat 6,197,130), further in view of Ganyo et al. (U.S. Patent 5,650,026).

Referring to independent claim 1, Applicant discloses and claims a method for providing improved heat treatment conditions for a precipitation hardenable alloy defined by the following limitations (emphasis added):

a) affecting the temperature of the alloy to change an amount of a first precipitate phase relative to an amount of a second precipitate phase;

b) **sensing an instantaneous temperature** of the alloy and providing a signal in dependence thereof;

c) **calculating a value** indicative of a current precipitate-phase composition of the alloy **according to a series of predetermined rate equations** and in dependence upon the provided signal;

d) comparing the calculated value to a predetermined threshold value; and,

e) affecting the alloy in dependence upon a result of the step of comparing,

wherein the predetermined threshold value is characteristic of an alloy having at least one of an indicated yield strength, specific conductivity and corrosion property.

The above features define a highly advantageous process for providing heat treatment conditions for a precipitation hardenable alloy. During heat treatment, an instantaneous temperature of the alloy is sensed and based on the sensed temperature a value indicative of a precipitate-phase composition of the alloy at the time instance of the temperature measurement is determined according to a series of predetermined rate equations. The current value indicative of the current precipitate-phase is then compared with a predetermined threshold value, which is characteristic of an alloy having at least one of an indicated yield strength, specific conductivity and corrosion property, and in dependence upon the comparison result the alloy is affected, i.e. heat treated.

By sensing an instantaneous temperature of the alloy during heat treating and calculating a value indicative of a precipitate-phase composition of the alloy at the time

instance of the temperature measurement according to a series of predetermined rate equations, the method as defined at claim 1 enables a highly accurate temperature control of the heat treating process in order to accurately achieve predetermined properties such as yield strength, specific conductivity, and corrosion resistance of the heat treated alloy. This is possible by combining the instantaneous temperature measurement of the alloy during heat treating with the determination of the precipitate-phase composition of the alloy at the time instance of the temperature measurement based on a series of rate equations as defined by the above features b) and c).

Cantrell et al. teach a method and apparatus for non-destructive testing during heat treating of an alloy. As a workpiece is heat treated it is insonified with an ultrasonic signal. A second harmonic of the signal is monitored and used to indicate changes in material strength of the workpiece. In order to relate changes of the second harmonic – or a non-linearity parameter – to the hardness of the workpiece, a calibration process is performed. In the calibration process, samples in predetermined time intervals during a heat treating process were taken, cooled to room temperature, and a Vickers hardness test was performed. In particular, in col. 4 lines 5-9, Cantrell et al. teach acoustically coupling an acoustic source and transducer to the workpiece and as the workpiece is heat treated insonifying the workpiece and monitoring the response, i.e. an instantaneous response of an ultrasound signal is sensed. Further, in col. 4 lines 23-28, Cantrell et al. teach utilizing the signal measurements to calculate the acoustic non-linearity parameter, which can be used to indicate changes in material strength or hardness, i.e. calculating a parameter relating the acoustic response signal to material strength or hardness of the workpiece.

Ganyo et al. teach heating of a plurality of metallic parts having different initial temperatures to a final temperature using infrared heating lamps. For temperature control non-contact temperature sensors are provided to measure an intensity of infrared radiation emitted from the metallic part to be heat treated. During temperature measurements the metallic parts are shielded from the infrared heating lamps to avoid interference – col. 3 lines 7-10, i.e. the teachings of Ganyo et al. do not enable sensing an instantaneous temperature of the metallic part.

Applicant respectfully submits that no combination of the cited references teaches each and every feature of the instant invention in as complete detail as is recited at claim 1. In particular, the combined references fail to teach or even suggest the highly advantageous features of instantaneous temperature measurement of the alloy during heat treating and calculation of a numerical value indicative of a precipitate-phase composition of the alloy at the time instance of the temperature measurement based on a series of rate equations.

The invention as claimed in claim 1 gives rise to the advantages outlined in paragraph [0035] of the specification and, furthermore, the invention is useful for arbitrary temperature treatment profiles as stated in the application as filed. The method taught by Cantrell et al. requires a calibration process to associate the acoustic response with the desired material property as a function of temperature, i.e. a different calibration is required for each different temperature function, whereas according to the present invention as claimed the current composition is calculated based on the use of rate equations followed by determining the additional treatment necessary to achieve a predetermined material property. Use of different temperature – or heating – functions does not affect this calculation as long as initial values and "thermal exposure" are known and accounted for.

Applicant respectfully submits that claim 1 is not obvious in light of the teachings of Cantrell et al. in view of Ganyo et al. and is, therefore, allowable.

Referring to dependent claim 2, Applicant respectfully submits that Cantrell et al do not teach the features a1) to a3), but merely heat treating of samples at a constant temperature for 12 hours while providing an acoustic signal and sensing a response, removing some of the samples in 72 min increments, cooling the same for determining a Vickers hardness for obtaining a relation between the acoustic response signal and the hardness of the sample.

Referring to dependent claims 3 to 7, Applicant respectfully submits that Cantrell et al. do not teach the features of these claims but merely teach in col. 3 lines 10-58, cited by

the examiner, a process to obtain the non-linearity parameter as function of time for heat treatment at 190 °C, as shown in Fig. 1.

Claims 2-8, and 12 each depend from a claim which is believed to be allowable and are therefore also believed to be allowable.

Applicant has amended independent system claim 14 to more clearly define the claimed invention. In particular, claim14 has been amended to include the value being calculated "according to a series of predetermined rate equations" in order to be corresponding to independent method claim 1. The amendment does not add new subject matter.

Accordingly, amended independent claim 14 is a system claim for implementing the method defined by claim 1. Applicant respectfully submits that no combination of the cited references teach the feature of (emphasis added): "*a processor for executing code thereon to calculate a value in dependence upon the signal and* ***according to a series of predetermined rate equations****, the value indicative of a current precipitate phase composition of the sample, and for comparing the calculated value to a predetermined threshold value*."

Applicant respectfully submits that claim 14 is not obvious in light of the teachings of Cantrell et al. in view of Ganyo et al. and is, therefore, allowable.

Applicant respectfully submits that each of claims 15 and 16 depend on a claim that is believed to be allowable and as such are also believed to be allowable.

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cantrell et al (U.S. Pat 6,197,130), further in view of McCay et al. (U.S. Patent 6,350,326).

Applicant respectfully submits that claim 9 depends from believed allowable claim 1. Accordingly, claim 9 is also believed to be in proper condition for allowance and favorable consideration is kindly requested.

Applicant looks forward to receiving favourable consideration of the present application.

Please charge any additional fees required or credit any overpayment to Deposit Account No: 50-1142.

Respectfully submitted,

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